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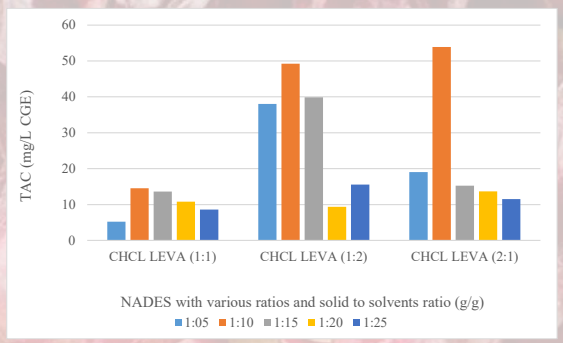
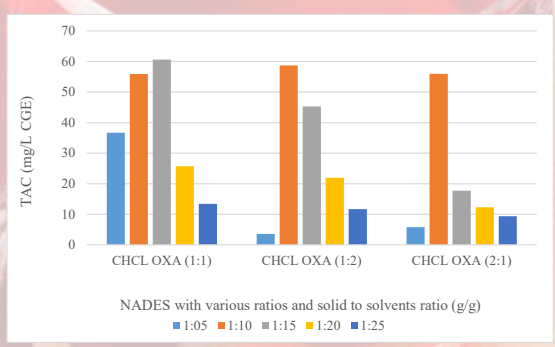
Natural Deep Eutectics Solvents: A Green Approach to Extracting Anthocyanins from *Hibiscus Sabdariffa*



TAC (mg/L cyanidin-3-glucoside equivalent) against ratio of HBA and HBD and solid-to-solvent ratio (g/g) for ChCl: Levulinic acids NADES



TAC (mg/L cyanidin-3-glucoside equivalent) against ratio of HBA and HBD and solid-to-solvent ratio (g/g) for ChCl: Oxalic acid NADES

The increasing demand for natural food colourants has driven research toward replacing synthetic dyes with safer, plant-based alternatives. One notable example is the vibrant red pigment from *Hibiscus sabdariffa*, commonly known as roselle. This pigment, rich in anthocyanins, offers significant nutritional benefits. Traditional extraction methods, such as maceration and Soxhlet extraction, are inefficient, requiring large amounts of volatile organic solvents and considerable energy.

Our study addresses these limitations by exploring the use of natural deep eutectic solvents (NADES) in combination with microwave-assisted extraction (MAE). NADES are formed from a mixture of hydrogen bond acceptors (HBAs) and hydrogen bond donors (HBDs), offering high versatility, low vapour pressure, and excellent thermal stability. By experimenting with different HBA and HBD ratios, we aimed to optimize the extraction of anthocyanins.

We discovered that NADES comprising choline chloride (ChCl) and oxalic acid in a 1:1 ratio significantly improved the extraction efficiency, yielding 60.60 mg/L of total anthocyanins content (TAC). This method demonstrated superior performance compared to ChCl paired with levulinic acid at a 1:15 solid-to-solvent ratio due to its higher polarity and selectivity.

These findings are pivotal for the food industry, offering a greener, more efficient extraction method for natural colourants. By reducing reliance on synthetic dyes, this approach can enhance food safety and sustainability. Furthermore, the use of NADES in MAE could revolutionize the extraction of bioactive compounds, promoting the development of healthier, eco-friendly food products.

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